



Physical Anthropology Section – 2007

H55 Isotopic Determination of Region of Origin in Modern Peoples: Applications for Identification of U.S. War-Dead From the Vietnam Conflict II

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After attending this presentation, attendees will understand the benefits and limitations of undertaking a multi-element approach when utilizing stable isotopes for determining region of origin of human dental remains.

This presentation will impact the forensic community and/or humanity by providing information on a method that may facilitate identification of unknown individuals. The method uses multi-element stable isotope analysis of human dental tissues to suggest the natal origin of individuals. It is anticipated that this technique will be especially useful as a lead generator for human remains that have been recovered/obtained from either unknown, unreliable, or suspect contexts.

This study is novel in that it is the first of its kind, in a forensic setting, to compile a large reference sample of isotopic ratio values of multiple elements from individuals with known natal regions. The goal of the study was to create a database of "geolocational fingerprints" utilizing carbon, oxygen, strontium, and lead isotope ratios sampled from the teeth of modern people. This database is intended to assist in determining the region of origin for unidentified skeletal material without an established or well-documented provenance. The preliminary efforts of this project focused on determining the natal isotopic signatures individuals from Southeast Asia and the United States of America. These regions were primarily selected in order to assist the effort to identify the approximately 1,800 U.S. service personnel who remain unaccounted for from the Vietnam conflict, but the results also apply to the identification efforts for service personnel who are missing from the Korean War and the Pacific theater during World War II. The authors utilized the operating hypothesis that the isotope ratios incorporated into Southeast Asian and American dental enamel during childhood are distinct and that these differences can be used to determine region of origin.

An East Asian reference population of 61 individuals was sampled from the Joint POW/MIA Accounting Command-Central Identification Laboratory (JPAC-CIL) "Mongoloid hold" collection. This collection consists of remains unilaterally turned over to the CIL that have been identified as originating in East Asia, but that have been refused repatriation by their country of origin. The isotopic ratios derived from the enamel of the East Asian reference sample were compared against those obtained from the third molars of 228 patients who underwent recent dental extractions with the 10th Dental Squadron, United States Air Force Academy, Colorado Springs, Colorado. Living subjects completed surveys detailing their childhood residency and physiological, behavioral, and cultural factors that might potentially affect isotopic deposition in enamel.

While the ranges of all isotopes examined overlapped to an extent for the two populations, the least squares means for all isotope values examined exhibited statistically significant differences between the East Asian and American cohorts, based on the results of a conservative multivariate analysis of variance. A linear discriminant function was created that correctly classified individuals, through resubstitution and cross-validation, as belonging to one of these two groups by 95% or better. Strontium values from individuals reared for a portion of their childhood in the U.S. displayed a distinct trend toward homogenization, with the mean value for $^{87}\text{Sr}/^{86}\text{Sr}$ varying only slightly from that of seawater. Additionally, semi-quantitative calculations of enamel lead concentrations indicated the concentration of lead in the East Asian teeth was at least an order of magnitude greater than the American values, hinting at another potential discriminating factor.

When compared to isotopic signatures developed for geographic areas of Southeast Asia, the information in this study will assist in identifying the origin of unknown dental remains undergoing analysis by the JPAC-CIL. These data will serve as the foundation for a more comprehensive database of modern, human, geolocational isotope values that will assist not only in the identification of fallen servicemen and women, but could have potentially far wider reaching applications in the identification of victims of mass fatality incidents, undocumented and otherwise unknown suspected aliens who perish attempting entry into the U.S., and local "Jane and John Doe" cases by allowing for the inclusion or exclusion of potential matches based on geographic natal regions.

Stable Isotopes, Geographic Origin, Vietnam Conflict